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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/076,099	02/15/2002	Wayne L. Johnson	P 273243 PC0033A Reg	8536

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EXAMINER
MCDONALD, RODNEY GLENN

ART UNIT	PAPER NUMBER
1753	5

DATE MAILED: 09/05/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/076,099	JOHNSON ET AL.	
	Examiner	Art Unit	
	Rodney G. McDonald	1753	

-- Th MAILING DATE of this communication app ars on th cover sh t with th correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-26 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-26 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 11/2, 4 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 7-11, 15-17 are rejected under 35 U.S.C. 102(b) as being anticipated by Heinecke et al. (U.S. Pat. 4,824,690).

Heinecke et al. '690 teach ***a pulsed radio frequency plasma deposition process the pulse repetition frequency is matched to the gas exchange rate.*** This is achieved by using ***a pulse width of 50 to 500 microseconds*** and a pulse repetition rate corresponding to the time within which gas is exchanged in the reaction region. (See Abstract)

The gas within the chamber 11 is then changed to a gas or vapor, or mixtures thereof to effect deposition of a surface coating on the device 11. To effect this deposition the pulse repetition rate of the generator is matched to the dissociation rate of the plasma. (Column 2 lines 28-32)

We have found that the effect of each ***radio-frequency pulse is to dissociate the plasma gases*** and thus deplete the active gas content of the chamber 11. Since the length of the pulse is short there is substantially no gas exchange during the pulse. This provides substantially uniform deposition conditions throughout the chamber volume. Immediately after the pulse the chamber contains a substantially uniform

plasma in a high degree of dissociation i.e. a high degree of dissociation of the plasma has occurred. (Column 2 lines 42-51)

We have found that dissociation rate of a reactive gas is up to two orders of magnitude slower than the establishment of the plasma, the latter occurring within a few microseconds. To maximize the deposition efficiency the plasma should be maintained for a period of at least 50 microseconds and preferably from 75 to 500 microseconds. We have found that for many plasmas a pulse width of 100 to 400 microseconds provides the optimum deposition conditions. The preferred mark space ratio is from 1:300 to 1:1200. (Column 2 lines 52-61)

A first deposition process can take place and then a second process can take place with different gases. (Column 2 lines 62-65)

The power density during the plasma processing during the first and second processings discussed above must be between 100 to 1000 watts/cc so that a high degree of dissociation occurs. (Column 4 lines 26-28) (Thus the energy level is selected for the processes performed for dissociation)

In some applications the reactant gas or gases may be fed into the chamber in a series of pulses, one pulse for each generator pulse. In a further extension of this technique the gas is changed at every pulse to a different composition or to an inert gas. (Column 3 lines 52-53; Column 4 lines 1-6)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-3, 7-11 and 15-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heinecke et al. (U.S. Pat. 4,824,690).

Heinecke et al. '690 is discussed above and all is as applies above. (See Heinecke et al. discussed above)

The differences between Heinecke et al. '690 and the present claims is that the wave form is not discussed and the introducing gases of different composition in intermittent manner is not discussed.

Heinecke et al. '690 teach utilizing ***RF*** power which inherently ***has a sinusoidal wave form.*** (See Heinecke et al. discussed above)

Heinecke et al. '690 teach introducing ***different gas*** at each pulse at Column 4 lines 1-6.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Heinecke et al. '690 by utilizing a sinusoidal waveform and introduced different gases intermittently as taught by Heinecke et al. because it allows for eliminating spatial depletion gradients whilst improving gas utilization.

Claims 4-6 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heinecke et al. ' 690 as applied to claims 1-3, 7-11 and 15-17 above, and further in view of Heinecke et al. (U.S. Pat. 4,935,661).

The differences not yet discussed is the control of the energy level and cyclically varying gas pressure.

Heinecke et al. '661 teach an apparatus for pulsed treatment of a substrate surface which includes means for removing spent gas from a region adjacent the substrate for each pulse. The apparatus may also include means for sweeping an intense plasma region across a substrate surface. Rapid gas exchange is provided by pressure pulsing the gas admission. This facility also provides means for rapidly alternating different gases. (See Abstract)

The arrangement shown in Fig. 4 provides a facility for changing the reactant gas from one gas to another with each plasma pulse (or succession of pulses). (Column 6 lines 18-22) To assist gas exchange a gas pulse facility may be provided by the arrangement of Fig. 4a. The amount of gas stored in the vessel 34 should be that which

fills the reactor to the required operating pressure measured by the control 15, ***which pressure may change from pulse to pulse,*** and which is then maintained via the flow meter 30 during the remainder of the plasma pulse. Vessel 34 thus also acts as a buffer to prevent the mass flow controller trying to follow the pulsings. (Column 6 lines 42-55)

As well as film deposition the technique can also be used for etching. For example, using an electrode separation of 20 mm and argon gas at 140 mtorr ***the bias voltage on the ground electrode was varied in the region 0 to -500 V DC to obtain an enhanced plasma which increased the etch rate of SiO whilst decreasing the resist degradation on a patterned Si wafer.*** (Column 11 lines 23-29)

The motivation for control of the energy level and cyclically varying the gas pressure is that it allows overcoming the disadvantages of the prior art. (Column 1 lines 3-55)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have controlled the energy and vary the gas pressure as taught by Heinecke et al. '661 because it allows for overcoming the disadvantages of the prior art.

Claims 12-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heinecke et al. ' 690 as applied to claims 1-3, 7-11 and 15-17 above, and further in view of Ooiwa et al. (U.S. Pat. 4,891,118).

The differences not yet discussed is applying an rf bias voltage to the substrate holder with a pulse.

Ooiwa et al. teach an ***RF bias voltage is applied to the substrate*** during the process. By ***optimizing the RF bias voltage*** which the ***pulses*** of microwaves the apparatus produces a higher quality thin film, or etching process, without damaging the substrate surface. (See Abstract)

The motivation for utilizing a pulsed Rf voltage to the substrate is that it prevents damaging the substrate surface. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized an RF bias voltage to the substrate with a pulse as taught by Ooiwa et al. because it prevents damaging the substrate surface.

Claims 19—21, 23, 24 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over in Heinecke et al. (U.S. Pat. 4,824,690) view of Mahawili (U.S. Pat. 4,993,358).

Heinecke et al. is discussed above and all as applies above. (see Heinecke et al. discussed above) Heinecke et al. teach at Column 2 line 2 ***a chamber*** for a plasma, at Column 2 lines 14-15 ***an inlet manifold 16*** via an inlet tube 17 for supplying gases or vapours, at Column 2 lines 4-5 a coil 2 connected to ***a pulsed radio frequency generator 13*** for creating an electromagnetic field, at Column 2 lines 2-3 a device 10 which is mounted within the vacuum chamber 11 ***(the place of mounting is presumed to be the substrate holder)***, and at Column 2 lines 12-13 ***a pump 15*** to evacuate the plasma region. Heinecke et al. also discusses ***pulsing the gases fed into the chamber*** at Column 3 lines 53; Column 4 lines 1-2.

The differences not yet discussed is the feeding of the gases through a manifold that has a plate with a plurality of nozzles and valves, each for supplying gas, and valve control means for controlling the nozzles intermittently.

Mahawili teach "vertical systems" including a susceptor for holding wafers in a chamber typically formed by an inverted bell jar. The susceptor is typically rotated for achieving greater uniformity in coatings across the surface of the wafers or substrate. (Column 1 lines 60-64)

It is further object of the invention to provide CVD reactor with a housing forming a closed chamber suitable for maintaining a wafer or deposition substrate in a controlled environment of selected pressure, etc. With the substrate supported in the chamber, and maintained at typical CVD temperatures, it is subjected to a deposition environment formed with means for introducing reactant gas into the chamber. (Column 2 lines 38-45)

More preferably, the means for introducing reactant gas into the chamber comprise multiple spaced apart orifices, sets of the orifices being in communication with external manifolds preferably of annular configuration. The arrangement of the external annular manifold permits the use of separate regulators in order to introduce one or more gases including reactant gases, carrier gases and the like as necessary for a particular deposition process being contemplated. The invention also contemplates possible use of a portion of the orifices as additional exhaust vents in order to make the CVD reactor or apparatus even more versatile. (Column 3 lines 6-18)

The CVD reactor comprises an upper or external ***plate 28*** forms ten radially spaced gas manifolds. (Column 4 lines 19-20) The inner plate 30 forms an array of gas inlets, ***preferably sonic orifices generally indicated at 32A-50A.*** (Column 4 lines 22-23) Each of the annular gas manifolds 32-50 is provided with ***an external valve or regulator 32C-50C in an inlet conduit 32D-50D. The external regulators are adapted for connection with one or more sources of reactant gases such as those schematically indicated at 56 and 58.*** Depending upon the specific application, different numbers of individual gas source could be employed. In any event, the two sources 56 and 58 indicate the possibility of combining two or more gases to form the reactant gas environment within the chamber 24. For example, in the deposition of silicon dioxide, the two sources 56 and 58 could provide silane and oxygen. However, as noted above, a wide variety of other gases could be employed as contemplated by the present invention In any event, ***the gas sources 56 and 58 are selectively connected with one or more of the external regulators in order to assure optimum flow conditions for the reactant gas within the chamber 24.*** The sources 56 and 58 could be connected with the external regulators, for example, by conduits or the like (not shown). (Column 4 lines 45-65)

At least one additional exhaust passage 66 is formed in an axially central portion of the chamber 24, preferably by the plates 28 and 30. The exhaust passage 66 is similarly in communication with an external exhaust member 68 having an individual control valve 70. The external exhaust members 62 and 68 may be connected for example with a vacuum pump as schematically indicated at 72, for

example by conduit or the like (not shown). ***Additional exhaust passages (not shown) could be provided in the center of the chamber 24, if desired.*** (Column 5 lines 10-19)

The control valves 64 and 70 are adapted for sequential operation, preferably by ***automated means (not shown) in order to selectively open or close the individual exhaust passages 60 and 66 between the chamber 24 and vacuum means 72.*** (Column 5 lines 20-24)

The combination of control valves 64 and 70, either alone or in combination with the automated means referred to above, provides a kinetic means for regulating directionality of local flow vectors for reactant gas within the chamber 24 as described in greater detail below in a method of operation for the reactor 10. (Column 5 lines 25-30)

The motivation for providing for feeding of gases is that it allows for enhancing coating uniformity. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized gas feeding means as taught by Mahawili because it allows for enhancing coating uniformity.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Heinecke et al. '690 in view of Mahawili as applied to claims 19-21, 23, 24 and 26 above, and further in view of Bates et al. "Fast gas injection system for plasma physics", Rev. Sci. Instrum., Vol. 55, N0. 6, June 1984.

The differences not yet discussed is the use of a piezoelectric valve to regulate the gas flow.

Bates et al. teach a gas injection system that utilizes ***a piezoelectric valve***. (See Bates et al. Abstract)

The motivation for utilizing a piezoelectric valve for a gas injection system is that it allows faster controlled injection. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a piezoelectric valve to control gas injection as taught by Bates et al. because it allows for faster control of gas.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Heinecke et al. '690 in view of Mahawili as applied to claims 19-21, 23, 24 and 26 above, and further in view of Eres et al. (U.S. Pat. 5,164,040).

The differences not yet discussed is the use of supersonic gas injection.

Eres teach injecting into the chamber a gaseous source of material in the form of ***a pulsed supersonic jet*** so as to obtain a high incidence rate. ***The supersonic jet is produced by a pulsed valve*** between a relatively high pressure reservoir, containing the source gaseous molecules, and the deposition chamber. (See Abstract)

By alternately pulsing two nozzles, epitaxial structures can be formed in which successive layers have different compositions. (Column 4 lines 5-10)

The motivation for utilizing supersonic gas flow is that it allows for having a high incidence rate. (See abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a supersonic gas injection nozzle as taught by Eres et al. because it allows for having a high incidence rate.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 703-308-3807. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 703-308-3322. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Rodney G. McDonald
Primary Examiner
Art Unit 1753

RM
September 4, 2003